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Phytogeographical notes on the Rocky Mountain region
V. Grasslands of the Subalpine and Montane Zones

P. A. Rydberg

In a previous paper, I have discussed the forest trees of the mountains proper. Next to the trees the most important vegetation consists of the grasses. In fact, it may be said that in most cases where the land is not covered by the forest, the grasses are the predominant plants. The principal exceptions are the following: (1) Lakes and ponds, as the aquatic grasses are few and there are no aquatic trees. (2) Rock-slides and bare cliffs, where the soil is too scant. As soon as humus and sediments have had time to increase the soil, regions of this type will gradually change into either a forest-formation or a grassland. (3) Shrub formations. These are not very common in the mountains, but more so in the foothills. They are mostly found on the borders between the forest and the grassland, and in time will change into either, usually into the former. (4) Certain brook banks, especially in the subalpine region, where the vegetation consists of species of *Mertensia*, *Senecio*, *Delphinium* and other dicotyledonous plants.

Usually the forest occupies the slopes, while the grasslands occupy either the elevated ridges or so-called "hog-backs," or else the valleys or so-called "parks." The cause of this division is pointed out, or at least suggested, in one of my preceding papers on the alpine region.* The "hog-backs" are exposed to the desiccating winds and are therefore too dry for forest growths. In the valleys too much snow lodges during the winter and melts too slowly during the summer and the trees would be suffocated. There may also be other causes. In the valleys and parks, the drainage is often too poor and the soil has become too alkaline or saline for tree growth.

The grasslands are, however, not wholly confined to the ridges and valleys. In many places, the slopes where the soil and drainage are both good and where there is no special exposure either to wind or snow are occupied by grasses and not by forest. In such cases it is harder to point out the causes of the conditions. In some cases the forests have been destroyed by fires, and the grasses have gained possession of the ground before a reforestation had taken place.

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* Bull. Torrey Club 40: 681, 682. 1913.

A. SUBALPINE ZONE

The grasslands of the Subalpine Zone resemble much those of the Alpine Zone, which has been treated in a previous article. They are, however, of comparatively less extent, only covering larger areas in the more open valleys, where too much snow lodged, and along the wind-swept "hog-backs." The former are practically a continuation of the alpine meadows, the latter of the mountain crests. The grasses are mostly the same with some additions from the Montane Zone below. The grasses confined to the Subalpine Zone only are indeed very few.

Species in the following lists marked with an asterisk (*) are restricted to the lower parts of the zone; those marked with a dagger (†) to the upper part.

I. LAKES, PONDS, BROOKS and SWAMPS

Lakes or ponds are very rare in the Subalpine Zone; they are mostly situated in amphitheaters immediately under the snow fields and are usually filled with ice until late in the spring. They are almost void of higher vegetation, which is limited to a few species of *Sparganium* and *Potamogeton*. There are, as a rule, no grasses. The only aquatic grass in the upper part of the Zone is *Catabrosa aquatica*, which is usually confined to the mountain brooks in places where the current is less swift. In the lower part of the Zone is added to this *Panicularia pauciflora*, growing in willow bogs. Th ecommon water grasses of the lower mountain regions and the Great Plains are wanting: viz. *Phragmites*, *Spartina*, *Calamagrostis*, *Panicularia americana*, and *Phalaris*.

2. MEADOWS

The wet meadows are confined to the lower and moister parts of the open valleys. In the upper part of the Zone they are practically identical with the Alpine meadow-lands; in the lower part a number of species from the Montane Zone are added. Along the water courses perhaps the most common grass in the upper part is _Deschampsia caespitosa._ Where the soil is richer the predominant grasses are _Phleum alpinum_, _Agrostis variabilis_, _Trisetum subspicatum_, _T. majus_ and several species of _Poa._ In the lower part these, except the poas, are more or less replaced by _Alopecurus aristulatus_, _Muhlenbergia comata_, _Agrostis asperifolia_, _Graphephorum muticum_, and _Danthonia californica._ Among bushes, especially along the streams, the most common grasses are _Calamagrostis canadensis_, _C. Langsdorfii_, _Panicularia nervata_, and _P. pauciflora._ In the Northern Rockies many wet meadows are made up wholly of _Alopecurus occidentalis_, but this species is rare in the Southern Rockies.

The following grasses are found in the Subalpine Zone throughout the whole Rocky Mountain region:

*_Muhlenbergia racemosa_
*" _comata_
*_Phleum pratense_
" _alpinum_
*_Alopecurus aristulatus_
" _occidentalis_
*_Agrostis asperifolia_
" _hyemalis_
" _variabilis_
Calamagrostis Langsdorfii
" _canadensis_
*_Deschampsia atropurpurea_
†" _curtifolia_
" _caespitosa_

Trisetum subspicatum
" _majus_
*_Graphephorum muticum_
*_Danthonia californica_
*" _intermedia_
Poa pratensis
" _reflexa_
" _leptocoma_
" _alpina_
*" _Olneyi_
*" _Vaseyana_
*_Panicularia nervata_
" _pauciflora_
*_Hordeum jubatum_

The following are restricted to one of the two divisions:

Southern Rockies

Muhlenbergia Wolfii
*_Agrostis canina_
†_Deschampsia alpicola_
Graphephorum Wolfii

Poa callichroa
†" _pudica_
" _occidentalis_
*" _tricholepis_

Northern Rockies

Agrostis variabilis

Poa nervosa

The following mesophytic grasses, which could be counted among the meadow-grasses, prefer, however, river banks more or less covered by shrubbery.

Calamagrostis Langsdorfii
" *canadensis*
Trisetum montanum
**Elymus glaucus*

3. Dry Valleys and Bench-lands

Sometimes the sides of the valleys slope gently and the meadow passes gradually into the dryer part of the valley and this into the mountain side, sometimes the sides rise in a series of steps or shelves, one above the other. These steps are the remains of former river-banks or lake-shores. They are known as benches. The grasses of the bench-lands and other drier portions of the valleys are decidedly xerophytic. They consist mostly of genera which are characteristic of the Great Plains or the Foot-hills. In the Subalpine Zone the bench-lands are not often found and are always of insignificant area. The following grasses are characteristic of the bench-lands of the Subalpine Zone:

Stipa Tweedyi
" *minor*
Poa crocata
" *longiligula*
" *lucida*
" *Buckleyana*
Bromus Porteri
" *Richardsonii*
" *polyanthos*
Agropyron violaceum
Elymus simplex

4. Mountain Slopes

Sometimes the meadow passes gradually into the mountain slopes, without any intervening xerophytic region. The mountain grass-slope is often mesophytic in its nature, especially in the Subalpine Zone, and is much like that of the Alpine Zone. In the Northern Rockies the most important grass of such mountain sides is *Festuca ingrata*, which, however, has its best development in the Montane Zone. This grass is also common in the northern part of the Southern Rockies, but on the southern slopes of the latter its place is taken by *Festuca arizonica* and *F. Thurberi.* The latter for instance covers all the southern slopes of the Abajo Mountains in southeastern Utah, almost to the top (3,300 m. alt.). These slopes, however, are more xerophytic than the mountain sides of the Northern Rockies. The grass flora of the mountain sides is of the following composition:

Stipa minor
* " *Nelsonii*
Agrostis hiemalis
Trisetum subspicatum
" *majus*
Poa longiligula
" *paddensis*
" *epilis*
" *confusa*
" *laevigata*
Festuca ingrata
† " *saximontana*
Bromus Richardsonii
" *Pumpellianus*
Agropyron andinum
" *Scribneri*
" *violaceum*

The following are restricted to one region:

Southern Rockies

Muhlenbergia gracilis
" *subalpina*
Poa aperta
" *longipedunculata*
Poa Fendleriana
" *Sheldonii*
Bromus Porteri

Northern Rockies

**Poa Cusickii*
" *nevadensis*
†*Agropyron latiglume*

Southern slope of the Southern Rockies

On the more xerophytic southern slopes of the Rockies of Colorado and New Mexico, the following species are the characteristic ones:

Trichachne saccharatum
Poa crocata
" *Fendleriana*
Festuca arizonica
" *Thurberi*
† " *saximontana*

5. HOG-BACKS

As stated before, the grass flora of the hog-backs or exposed ridges is practically the same as that of the rock-crests of the alpine region, except that a few of the more mesophytic grasses, as for instance *Trisetum subspicatum* and *Deschampsia curtifolia*, are lacking. A few species from the Montane Zone are added.

The following species growing in both the Northern and Southern Rockies belong here:

Calamagrostis purpurascens
†*Poa rupicola*
  “ *crocata*
† “ *Pattersonii*
  “ *epilis*
  “ *paddensis*
  “ *longiligula*
Festuca curtifolia
  “ *saximontana*
†*Agropyron Scribneri*
† “ *andinum*

The following belong here also, but are restricted to but one region:

Southern Rockies	Northern Rockies
Muhlenbergia subalpina	*Poa confusa*
“ *filiculmis*	“ *Cusickii*
Festuca minutiflora	*Sitanion rigidum*

B. MONTANE ZONE

The grasslands of the Montane Zone resemble more those of the Great Plains and the Foothills. In the large open valleys or so-called parks, many of the grasses are the same as those found in the valleys of the plain region, in fact many have followed the streams up from the prairies. The grass flora of the bottoms of the canyons and of the river banks is also much the same as further down in the plain region. The flora of the elevated ridges and "hog-backs" also is more or less a continuation of that of the plains, with the addition of some endemic grasses. The grass flora of the mountain slopes consists more exclusively of grasses peculiar to the mountain regions.

Species in the following lists marked with an asterisk (*) are common to the Great Plains; those marked with a dagger (†), to the Subalpine Zone. Species marked with a double dagger (‡) are northern species found at low altitudes throughout the boreal regions but not on the Great Plains or the Prairies; in the Rocky Mountains they are restricted to the Montane and Subalpine Zones. Species marked with a section (§) occur also on the Staked Plains and in the Upper Sonoran region.

1. LAKES, PONDS AND SWAMPS

The water grasses are not many. _Catabrosa aquatica_ is mostly confined to slow running brooks, _Phragmites Phragmites_, _Panicularia americana_ and _P. borealis_ are found in lakes and ponds mostly near the shore; so also are _Phalaris arundinacea_, _Agrostis asperifolia_, _Beckmannia erucaeformis_, and _Calamagrostis Langsdorfii_, but these prefer the bogs rather than the deeper water. The following belong to this formation:

Phalaris arundinacea
*_Calamagrostis hyperborea_
Agrostis asperifolia
*_Beckmannia erucaeformis_
‡†_Catabrosa aquatica_
*_Phragmites Phragmites_
*_Panicularia americana_
‡ " _nervata_
† " _pauciflora_
‡ " _borealis_

The following is restricted to the Northern Rockies:

Panicularia elata

2. MEADOWS

As in the Subalpine Zone the wet meadows are situated in the more open valleys, but they are here of greater extent, as the grade of the water courses is not so steep as in the higher regions. Many of the grasses are the same as those of the subalpine meadows and even some of the alpine species, such as _Poa alpina_ and _Phleum alpinum_, are occasionally found along the water courses, where the ground is kept cool by the ice water from the mountains. Still more species are common to this and the valleys of the Foothills and the Great Plains. The genera of Aveneae, such as _Deschampsia_, _Trisetum_ and _Graphephorum_, become more sparing, and those of Agrostideae, such as _Agrostis_, _Muhlenbergia_ and _Calamagrostis_, more common. The tribe Hordeae, rarely represented in the subalpine meadow, becomes also more frequent, especially the genus _Hordeum_ and the stoloniferous species of _Agropyron_. It is scarcely worth while to indicate the principal species, for in one meadow there might be one species predominant, in another there might be another species. In the Northern Rockies the predominant species in many places are _Alopecurus occidentalis_, _Agrostis alba_, _Phalaris arundinacea_, or _Festuca vallicola_, but in the Southern Rockies this is rarely if ever the case. Here the species of _Poa_ are usually predominant. The following grasses inhabit the montane meadows:

*_Phalaris arundinacea_
Muhlenbergia racemosa
" _Richardsonis_
* " _comata_
" _filiformis_
Phleum pratense
† " _alpinum_
*_Alopecurus aristulatus_
" _occidentalis_
Agrostis alba
" _asperifolia_
" _tenuiculmis_
* " _hiemalis_
†_Calamagrostis Langsdorfii_
" _canadensis_
" _Scribneri_
* " _neglecta_
* " _hyperborea_
" _micrantha_
†_Deschampsia caespitosa_
†_Trisetum majus_
Graphephorum muticum
Danthonia californica
" _intermedia_
*_Eatonia intermedia_
Melica spectabilis
" _bulbosa_
Poa pratensis
" _reflexa_
" _leptocoma_
* " _triflora_
† " _alpina_
" _Wheeleri_
" _Olneyi_
" _pratericola_
*_Panicularia nervata_
" _pauciflora_
*_Agropyron pseudorepens_
*_Hordeum jubatum_
* " _nodosum_
" _boreale_

The following are also found in the meadows, but are restricted to one region:

Southern Rockies

*_Muhlenbergia Wrightii_
Agrostis canina
*_Calamagrostis inexpansa_
Graphephorum Shearii
Graphephorum Wolfii
*_Poa interior_
" _tricholepis_
Agropyron Palmeri

Northern Rockies

Panicum pacificum
Muhlenbergia squarrosa
Agrostis humilis
" _aequivalvis_
" _variabilis_
Calamagrostis blanda
Calamagrostis laxiflora
*_Eatonia pennsylvanica_
Poa nervosa
" _longipila_
Festuca vallicola

Certain species are limited to, or more common in, the more alkaline meadows, which are quite wet in the spring but dry in the autumn. These are:

Puccinellia airoides
Spartina gracilis
Distichlis stricta
Elymus simplex
Agropyron Smithii
* " *molle*
* " *dasystachyum*
(Northern Rockies only)

A few species may be counted to the meadow flora, but they are found only in sandy places, on creek-banks, etc., and are limited to the Southern Rockies. These are:

Muhlenbergia simplex
" *aristata*
Muhlenbergia Wolfii

The following meadow species are usually most common among shrubs:

Eatonia pennsylvanica
Panicularia nervata
" *pauciflora*
Savastana odorata
Oryzopsis micrantha
Elymus glaucus

So also the following, which, however, are restricted to one region:

Southern Rockies	Northern Rockies
Stipa Porteri	*Melica subulata*
Panicularia Holmii	*Panicularia elata*
Festuca fratercula	*Festuca elatior*

3. DRY VALLEYS AND BENCH-LANDS

The dry valleys and bench-lands are more common and of greater extent in the Montane Zone than in the Subalpine, and more common in the Northern Rockies than in the Southern. Except in the three parks of Colorado (Northern, Middle and Southern) they are also as a rule smaller in the Southern Rockies. The grasses are composed mainly of two elements, the species common to the Great Plains and those endemic to the mountains. In the drier parts of the valleys there are scarcely any high northern ones running south in the mountains. In the southern portion of the Southern Rockies, there are a few species belonging to the Staked Plains and the Upper Sonoran flor The species of *Andropogon*, *Sporobolus*, and *Koeleria* and th stoloniferous species of *Agropyron* are immigrants from the Gre Plains, while those of *Stipa* (except *S. comata*) and most speci of *Bromus* are endemic. The species of *Poa* and the bunche species of *Agropyron* are divided between the two categorie The following belong here:

**Andropogon furcatus*
* “ *Hallii*
**Stipa comata*
“ *Tweedyi*
“ *viridula*
“ *Nelsonii*
“ *minor*
**Muhlenbergia Richardsonis*
**Sporobolus airoides*
* “ *asperifolius*
* “ *chryptandrus*
**Bouteloua oligostachya*
Poa crocata
“ *longiligula*
“ *laevigata*
“ *confusa*
* “ *praterícola*
* “ *Buckleyana*

**Koeleria gracilis*
Festuca campestris
Bromus polyanthus
‡ “ *Richardsonii*
“ *Pumpellianus*
‡*Agropyron violaceum*
* “ *tenerum*
‡ “ *caninum*
* “ *pseudorepens*
* “ *Smithii*
* “ *molle*
“ *spicatum*
**Hordeum jubatum*
**Sitanion elymoides*
Elymus triticoides
“ *condensatus*
“ *simplex*

The following also belong here but are restricted:

Southern Rockies

Andropogon chrysocomus
§*Blepharineuron tricholepis*
Poa lucida
Bromus Porteri

§*Festuca Thurberi*
§*Agropyron arizonicum*
§ “ *Bakeri*

Northern Rockies

Stipa Richardsonii
“ *Williamsii*
“ *Elmeri*
Muhlenbergia squarrosa

Calamagrostis montanensis
Poa nevadensis
Bromus breviaristatus
“ *Flodmanii*

Agropyron spicatum
“ *Richardsonii*
* “ *albicans*
Agropyron Gmelini
* “ *dasystachyum*
Sitanion montanum

4. MOUNTAIN SLOPES AND HILLSIDES

The mountain slopes in the Montane Zone resemble closely those of the Subalpine Zone, but are more common and of greater extent. The number of species is much larger. As stated under the Subalpine Zone, the most important species in the Northern Rockies is *Festuca ingrata*, and its place is taken on the southern slopes of the Southern Rockies by *F. arizonica* and *F. Thurberi*. The following species are represented in both the Northern and the Southern Rockies:

**Stipa viridula*
“ *Nelsonii*
“ *minor*
“ *Vaseyi*
Oryzopsis exigua
Agrostis hiemalis
†*Trisetum subspicatum*
† “ *majus*
Poa longiligula
† “ *epilis*
† “ *paddensis*
“ *laevigata*
†*Festuca saximontana*
“ *ingrata*
“ *confinis*
‡*Bromus Richardsonii*
“ *Pumpellianus*
†*Agropyron andinum*
‡ “ *violaceum*
* “ *tenerum*
**Sitanion elymoides*
**Elymus canadensis*

The following are restricted to one region:

Southern Rockies

**Trichachne saccharatum*
Stipa Scribneri
Muhlenbergia gracilis
* “ *subalpina*
Melica Porteri
Poa aperta
“ *macroclada*
“ *Fendleriana*
Poa longipedunculata
“ *Sheldonii*
§*Festuca fratercula*
§ “ *arizonica*
§ “ *Thurberi*
Bromus lanatipes
“ *Porteri*
§*Sitanion molle*

Northern Rockies

Stipa Richardsonii
“ *Lettermannii*
Poa Cusickii
“ *nevadensis*
Elymus innovatus
†*Agropyron latiglume*
“ *spicatum*

5. HOG-BACKS AND DRY RIDGES

The flora here consists mostly of grasses from the Great Plains intermixed with some elements from the Subalpine Zone. The grass flora is rather poor in number of species. This is especially the case if those common to the hillsides are eliminated. The flora includes the following grasses:

**Aristida longiseta*
* “ *Fendleriana*
Stipa viridula
**Calamagrostis purpurascens*
Avena americana
Danthonia intermedia
Bouteloua oligostachya
**Koeleria gracilis*
Poa crocata
† “ *paddensis*
†*Festuca brachyphylla*
† “ *saximontana*
†*Agropyron andinum*
† “ *Scribneri*
“ *spicatum*

The following are restricted to one region:

Southern Rockies

Stipa Vaseyi
†*Muhlenbergia subalpina*
“ *filiculmis*
Poa Fendleriana

Northern Rockies

†*Poa Cusickii*
**Festuca campestris*
†*Sitanion rigidum*
“ *lanceolatum*

To the preceding formations may be added the following five in which the grasses do not constitute the principal or predominant species:

6. WOODS

The truly wood species of grasses are very few, and even these do not grow in the deep forest but in more open places. They are the following:

Oryzopsis asperifolia
Cinna latifolia
Avena striata
Poa compressa
Festuca Jonesii

To these are added in the Northern Rockies:

Calamagrostis Suksdorfii
Deschampsia elongata

7. Coppices and River Banks

The following prefer more or less shaded situations among bushes, or on river banks among willows, birches, or alders:

§*Savastana odorata*
Stipa Richardsonii
Oryzopsis exigua
" *micrantha*
Calamagrostis canadensis
" *Langsdorfii*
Sporobolus cryptandrus
Panicularia nervata
" *pauciflora*
Festuca elatior
Elymus glaucus

Limited to one region:

Southern Rockies	Northern Rockies
Trisetum montanum	*Deschampsia elongata*
Panicularia Holmii	*Panicularia elata*
Melica Porteri	*Melica subulata*

8. Sand-draws and Sand-hills

A few species characteristic of the sand-hill regions of Nebraska and Kansas enter the river valleys, growing on sandy river-banks, draws, and in bottoms of canyons. They are:

Panicum barbipulvinatum
Eriocoma cuspidata
Muhlenbergia pungens
Festuca octoflora
Sporobolus asperifolius
" *confusus*
" *cryptandrus*

To these are added in the Southern Rockies:

Bouteloua prostrata
Muhlenbergia Thurberi
" *gracillima*
Munroa squarrosa
Elymus ambiguus

9. Hot Spring Formation

In the Northern Rockies, especially in the Yellowstone National Park, there are found many hot springs. The minerals held in solution in the hot water, mostly silicates, are deposited, forming often large fields of deposits in the form of crusts, which in course of time often become broken up and form sand fields. These hot spring formations have a peculiar flora of their own. The grasses are not many, however, but at least two of them have, so far as the writer knows, never been found elsewhere. These are *Panicum thermale* and *Deschampsia pungens*. The former has been collected also around hot springs in California. Besides these *Spartina gracilis* and *Panicum barbipulvinatum* are common. These are plants from the Great Plains, the former frequent in alkaline meadows and the latter in sand-draws. Another plant although not a grass, but a sedge, may be mentioned here, viz. *Eleocharis thermalis*, growing in the pools below the springs with water even too hot for a comfortable bath.

10. Ruderal Regions

A few of the ruderal grasses of the Great Plains and the regions east thereof have been found near dwellings, along roads, in fields and in waste places as high up as within the limits of the Montane Zone. These are:

Synthyrisma humifusum
Panicum capillare
" *barbipulvinatum*
Poa annua
Dactylis glomerata
Chaetochloa glauca
Polypogon monspeliensis
Avena fatua
Bromus hordeaceus
" *secundus*

New York Botanical Garden